

Ionic Compounds

Ionic compounds form from the combination of Metals and nonmetals.

Atoms that lose electrons are called cations and have a positive charge.

Atoms that gain electrons are called anions and have a negative charge.

Naming ionic compounds with metals that only form one ion

1. State the name of the first atom
2. Drop the last syllable (or 2) from the second atom name and add -ide.

Element	Name	Element	Name
C	Carbide	S	Sulfide
N	Nitride	Cl	Chloride
O	Oxide	Se	Selenide
F	Fluoride	Br	Bromide
P	Phosphide	I	Iodide

Name the following ionic compounds

Compound	Compound Name
CaBr_2	Calcium Bromide
Na_2O	Sodium Oxide
Ag_2S	Silver Sulfide
K_3P	Potassium Phosphide
Al_2N_3	Aluminum Nitride

Given the compound name, identify the ions involved and provide the chemical formula

Compound Name	Cation	Anion	Compound
Beryllium Chloride	Be^{2+}	Cl^-	BeCl_2
Sodium Sulfide	Na^+	S^{2-}	Na_2S
Lithium Phosphide	Li^+	P^{3-}	Li_3P
Magnesium Nitride	Mg^{2+}	N^{3-}	Mg_3N_2
Calcium Oxide	Ca^{2+}	O^{2-}	CaO

Naming Ionic Compounds Using the Stock System

Follow the 1st atom name by the Roman numeral that represents its charge in parenthesis

Example Copper (I) Chloride = CuCl or Copper (II) Chloride = CuCl_2

Name the following ionic compounds using the stock system

Compound	Cation	Anion	Name
FeCl_2	Fe^{2+}	Cl^-	Iron (II) Chloride
PbF_4	Pb^{4+}	F^-	Lead(IV) Fluoride
Sn_3P_2	Sn^{2+}	P^{3-}	Tin(II) Phosphide
CoO	Co^{2+}	O^{2-}	Cobalt(II) Oxide
CrP	Cr^{3+}	P^{3-}	Chromium(III) Phosphide

Provide the chemical formula give the names of the following ionic compounds

Name	Cation	Anion	Compound
Copper (II) Nitride	Cu^{2+}	N^{3-}	Cu_3N_2
Tin (IV) Oxide	Sn^{4+}	O^{2-}	SnO_2
Lead (II) Iodide	Pb^{2+}	I^-	PbI_2
Chromium (III) Phosphide	Cr^{3+}	P^{3-}	CrP
Iron (III) Bromide	Fe^{3+}	Br^-	FeBr_3

Ionic compounds that contain polyatomic cations or anions

There is only one polyatomic cation that you will be responsible for, NH_4^+ (ammonium ion)

When naming polyatomic anions, the charge for each member of a pair is the same. The ions differ by the number of atoms each member contains.

Example: SO_3^{2-} and SO_4^{2-}

The name of the member of the pair with the fewer number of atoms ends in -ite, the other ends in -ate.

SO_3^{2-} (sulfite) and SO_4^{2-} (Sulfate)

When forming compounds with polyatomic ions, place parenthesis around the entire ion before attempting to add subscripts (balance the charges)

Provide the names of the following compounds which contain polyatomic ions

Compound	Cation	Anion	Name
$\text{Ba}(\text{NO}_3)_2$	Ba^{2+}	NO_3^-	Barium Nitrate
MgSO_3	Mg^{2+}	SO_3^{2-}	Magnesium sulfite
$(\text{NH}_4)_3\text{P}$	NH_4^+	P^{3-}	Ammonium Phosphide
NaNO_3	Na^+	NO_3^-	Sodium Nitrate
$\text{Pb}_3(\text{PO}_4)_2$	Pb^{2+}	PO_4^{3-}	Lead (II) Phosphate

Form the compound containing polyatomic ions given the names

Name	Cation	Anion	Compound
Magnesium Phosphate	Mg^{2+}	PO_4^{3-}	$\text{Mg}_3(\text{PO}_4)_2$
Ammonium Sulfite	NH_4^+	SO_3^{2-}	$(\text{NH}_4)_2\text{SO}_3$
Calcium Hydroxide	Ca^{2+}	OH^-	$\text{Ca}(\text{OH})_2$
Lithium Nitrate	Li^+	NO_3^-	LiNO_3
Aluminum Sulfate	Al^{3+}	SO_4^{2-}	$\text{Al}_2(\text{SO}_4)_3$

Binary Molecular Compounds

Binary molecular compounds are made of non-metals.

When naming binary molecular compounds, always name the more metallic (least electronegative) ^{first.}

Naming Rules

1. If there is more than one of the 1st atom, precede the atom name by the appropriate prefix (di, tri, tetra, penta, hexa, hepta, octa, nona, deca)

Example: C_6O_2 hexacarbon dioxide

2. If there is only one of the first atom, do not precede the atom name by mono.

CO_2 = monocarbon dioxide

CO_2 = carbon dioxide

3. Precede the second atom name by the appropriate prefix, including mono if there is only one of that atom. Drop the last syllable (or 2) and add -ide to the element name

C_2O Dicarbon monoxide

Element	Name	Element	Name
C	Carbide	S	Sulfide
N	Nitride	Cl	Chloride
O	Oxide	Se	Selenide
F	Fluoride	Br	Bromide
P	Phosphide	I	Iodide

Provide the name of the following molecular compounds

Compound	Compound Name
P_6O_3	Hexaphosphorus trioxide
NS_4	<u>nitrogen tetrasulfide</u>
Se_8O	<u>octaselenium monoxide</u>
C_7Br_5	<u>heptacarbon pentabromide</u>
S_2F_2	<u>disulfur difluoride</u>

Provide the Chemical Formulas given the following names

Compound Name	Compound
Dinitrogen monofluoride	<u>N_2F</u>
Nonaphosphorus decachloride	<u>P_9Cl_{10}</u>
Sulfur hexabromide	<u>SBr_6</u>
Tetracarbon pentasulfide	<u>C_4S_5</u>
Octanitrogen trifluoride	<u>N_8F_3</u>

Acids

Acids contain hydrogen and an anion.

Binary acids contain hydrogen and a monatomic anion. (Ex. HCl)

Oxyacids contain hydrogen and a polyatomic anion, which contains oxygen (Ex. H₂SO₄)

Naming Rule for binary acids

1. Write hydro followed by the name of the anion with the ending changed to "ic".

Examples: HBr = hydrobromic acid

HF = hydrofluoric acid

Naming Rules for oxyacids

1. No prefixes. Do not use hydro.
2. If the acid is formed from an -ate ion, change the ending to -ic.

Example H₃PO₄ = phosphoric acid

3. If the acid is formed from an -ite ion, change the ending to -ous.

Example H₃PO₃ = phosphorus acid

Acid	Compound Name
HCl	Hydrochloric Acid
HNO ₂	Nitrous acid
H ₂ CO ₃	Carbonic acid
HI	hydroiodic acid

Acid	Cation	Anion	Formula
Phosphoric Acid	H ⁺	PO ₄ ³⁻	H ₃ PO ₄
Chromic Acid	H ⁺	CrO ₄ ²⁻	H ₂ CrO ₄
Hydroiodic Acid	H ⁺	I ⁻	HI
Sulfurous Acid	H ⁺	SO ₃ ²⁻	H ₂ SO ₃

Review– Naming Chemical Compounds

Circle the number of the compounds that you identify as covalent. Put a box around the number of the compounds you identify as acids. Name or write the formula for all of the compounds.

Name the following chemical compounds:

- 1) HBr Hydrobromic Acid
- 2) $\text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2$ Calcium acetate
- 3) P_2O_5 Diphosphorus pentoxide
- 4) $\text{Ti}(\text{SO}_4)_2$ Titanium sulfate
- 5) C_3P_4 Tricarbon tetraphosphide
- 6) K_3N Potassium ~~nitrate~~ nitride
- 7) SO_2 Sulfur dioxide
- 8) CuOH Copper (I) hydroxide
- 9) H_2CO_3 Carbonic Acid
- 10) Li_2S Lithium sulfide

Write the formulas for the following chemical compounds:

- 11) silicon dioxide SiO_2
- 12) Heptasulfur trinitride S_7N_3
- 13) manganese (II) phosphate $\text{Mn}_3(\text{PO}_4)_2$
- 14) phosphorus acid H_3PO_3
- 15) diboron tetrabromide B_2Br_4
- 16) magnesium sulfate MgSO_4
- 17) Hydrobromic acid HBr
- 18) ammonium oxide $(\text{NH}_4)_2\text{O}$
- 19) tin (IV) selenide SnSe_2
- 20) carbon tetrachloride CCl_4